Functional Films for Flexible CIGS Solar Cells

Insulation and Barrier Films

Principle

Oxide layers based on silicon or aluminium (e.g. SiO_2, Al_2O_3) are used as barrier films at the Zentrum für Sonnenenergie- und Wasserstoff-Forschung Baden-Württemberg (Centre for Solar Energy and Hydrogen Research, ZSW). These materials are insulators with a large band gap, and are characterised by their excellent transparency in the visible light spectrum and by their excellent insulating properties. Thanks to their amorphous or nanocrystalline structure, they also display very good diffusion-blocking characteristics. They are manufactured using microwave plasma-assisted CVD processes or cathode sputtering (reactive or partially reactive). With these deposition techniques, thin films with a thickness between a few nm and several µm can be produced. The maximum substrate size that can be coated homogenously is 30 cm x 30 cm.

Specifications

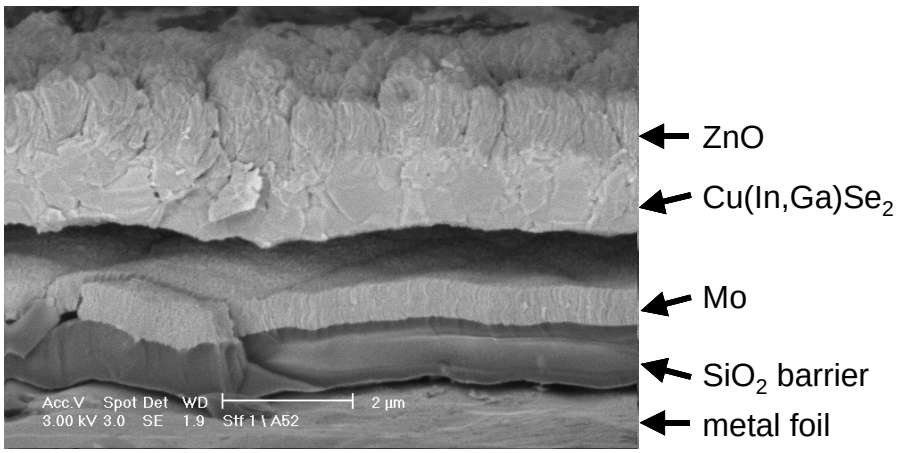
Plasma-CVD:	Plasmaline (Mügge Elektronik)
Inline sputtering unit:	LINA (Alcatel)
Laboratory sputtering unit:	LASA (Ardenne Anlagentechnik)
Materials:	SiO_2, Al_2O_3 (non-stoichiometric as well)
Substrate pretreatment:	Reactive ion etching

Requirements

Substrates suitable for vacuum deposition with a maximum size of 30 cm x 30 cm.

Sample applications

Barrier films are, for instance, used in flexible thin-film solar modules on metal foils, between the substrate and the actual solar cell: On the one hand, they provide electrical insulation, meaning that individual cells can be monolithically connected to form a module; on the other hand, they prevent diffusion of substrate elements into the absorber, which results in a better conversion efficiency. The following cross-sectional SEM image shows this type of substrate barrier with a Cu(In,Ga)Se2 solar cell on top.



Cross-sectional SEM image: $Cu(In,Ga)Se_2$ solar cell with a barrier on top of a flexible metal foil

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